

CONCRETE PAVEMENT
FOR
ROADS AND AIRFIELDS, less than 10,000 cubic yards
04/94

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1. APPLICABLE PUBLICATIONS: The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

1.1 Corps of Engineers Publications:

CRD-C 100-75 Sampling Concrete Aggregate and Aggregate Sources, and Selection of Materials for Testing.

CRD-C 130-77 Scratch Hardness of Coarse Aggregate Particles.

CRD-C 300-77 Membrane-Forming Compounds for Curing Concrete.

1.2 U.S. Department of Commerce, National Bureau of Standards (NBS), Handbooks:

H44 Specifications, Tolerances, and Other Technical Requirements for Commercial Weighing and Measuring Devices (Fourth Edition 1971 with Replacement Sheets 1977).

1.3 American Society for Testing and Materials (ASTM) Publications:

A 499-89 Steel Bars and Shapes, Carbon Rolled from "T" Rails.

A 615-92 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

A 616-92 Rail-Steel Deformed and Plain Bars for Concrete Reinforcement.

A 617-92 Axle-Steel Deformed and Plain Bars for Concrete Reinforcement.

A 675-90	Steel Bars, Carbon, Hot-Wrought, Special Quality Mechanical Properties.
C 31-91	Making and Curing Concrete Test Specimens in the Field.
C 33-92	Concrete Aggregate.
C 70-85	Surface Moisture in Fine Aggregate.
C 94-92	Ready-Mixed Concrete.
C 117-90	Materials Finer than No. 75-um (No. 200) Sieve in Mineral Aggregates by Washing.
C 123-92	Lightweight Pieces in Aggregate.
C 136-84 Aggregate.	Sieve Analysis of Fine and Coarse
C 142-90	Clay Lumps and Friable Particles in Aggregates.
C 143-90	Slump of Portland Cement Concrete.
C 150-92	Portland Cement.
C 171-92	Sheet Materials for Curing Concrete.
C 172-90	Sampling Freshly Mixed Concrete.
C 174-91	Measuring Length of Drilled Concrete Cores.
C 192-90	Making and Curing Concrete Test Specimens in the Laboratory.
C 231-91	Air Content of Freshly Mixed Concrete by the Pressure Method.
C 260-86	Air-entraining Admixtures for Concrete.
C 295-90	Petrographic Examination of Aggregates for Concrete.

C 494-90	Chemical Admixtures for Concrete.
C 566-84	Total Moisture Content of Aggregate by Drying.
D 881-87	Epoxy-Resin-Base Bonding Systems for Concrete.
D 1751-83	Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
D 1752-84	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
D 2628-81	Preformed Polychloroprene Elastomeric Joint Seals for Concrete Pavements.
D 2828-71 (R 1981)	Nonbituminous Inserts for Contraction Joints in Portland Cement Concrete Airfield Pavements, Sawable Type.
E 11-81	Wire-Cloth Sieves for Testing Purposes.

1.4 SUBMITTALS

Government approval is required for submittals with a "GA" designation; submittals having an "FIO" designation are for information only. The following shall be submitted in accordance with Section 01300 SUBMITTAL DESCRIPTIONS:

SD-08 Statements

Proportions of Mix; GA.

The results of trial mix along with a statement giving the maximum nominal coarse aggregate size and the proportions of all ingredients that will be used in the manufacture of each strength of concrete, at least 30 days prior to commencing concrete placing operations. Aggregate weights shall be based on the saturated surface dry condition. The statement shall be accompanied by test results from an independent commercial testing laboratory, attesting that the proportions selected will produce concrete of the qualities indicated. No

substitutions shall be made in the materials used in the work without additional tests to show that the quality of the concrete is satisfactory.

SD-09 Reports

Sampling and Testing; GA.

Certified copies of laboratory test reports, including all test data, for aggregate, admixtures, and curing compound. These tests shall be made by an approved commercial laboratory or by a laboratory maintained by the manufacturers of the materials.

SD-13 Certificates

Cementitious Materials; GA.

Manufacturer's certification of compliance, accompanied by mill test reports attesting that the materials meet the requirements of the specification under which it is furnished for cement or pozzolan. No cement or pozzolan shall be used until notice of acceptance has been given. Cement or pozzolan may be subjected to check testing by the Government from samples obtained at the mill, at transfer points, or at the project site.

2. COMPOSITION: Concrete shall be composed of cementitious material, fine aggregate, coarse aggregate, water, and an air entraining admixture.

3. STRENGTH AND AIR CONTENT: The proportioning of the mix, which shall be based on ACI 211.1, shall use materials approved by the Contracting Officer and in conformance with these specifications, shall be the responsibility of the Contractor. The Contractor shall design the mix to achieve a compressive strength [flexural strength] of 4,000 psi at 28 days [650 psi... or ___ at 90 days]. Seven day strengths are taken for the purpose of determining early strength of the concrete for construction loading and are not to be considered in evaluating the 28 day strength of the concrete. The air content of the concrete shall be maintained at 5 percent plus or minus 1 percent [6 percent plus or minus 1 percent in frost areas]. The Contracting Officer shall be notified prior to any changes to the proportions of the mix.

4. SAMPLING AND TESTING OF MATERIALS:

4.1 Cement and Pozzolan: Cement and Pozzolan will be accepted on the basis of the manufacturer's certification of compliance, accompanied by mill test reports, that cement meets the physical and chemical requirements of the specification under which furnished. Prior to using the cement and pozzolan

in the work, certificates of compliance and mill test reports shall be submitted in accordance with SPECIAL CLAUSES, for each mill lot of cement and pozzolan furnished from different mills in mixed shipment and for each separate shipment from the same mill. The temperature of the cement and pozzolan as delivered to the mixer shall not exceed 150 degrees F.

4.2 Admixtures:

4.2.1 Air-entraining Admixture: Air-entraining admixture will be accepted for use upon receipt of certification by the manufacturer of compliance with the provisions of ASTM C 260.

4.2.2 Water Reducing/ Retarder: Water/Reducing and retarding admixture will be accepted for use upon receipt of certification by the manufacturer of compliance with the provisions of ASTM C 494.

4.3 Aggregates: Fine and coarse aggregate sources will be accepted for use upon receipt of test data from an independent commercial laboratory indicating full compliance with the requirements of ASTM C 33, for each size of aggregate, and compliance with Deleterious Material requirements stated herein.

4.3.1 Production, Sampling and Testing of Aggregates: For each shift of concrete paving operation, the Contractor shall perform grading, fineness modulus, moisture content, particle shape tests and certain tests for suspect deleterious substances to determine conformance with the specification requirements. Grading, fineness modulus, moisture content, and particle shape tests shall be performed in accordance with PARAGRAPH: CONTRACTOR QUALITY CONTROL. Tests for suspect deleterious substances shall be performed on aggregate samples taken from the aggregate plant. During the first part of the paving operation, sampling and testing for these tests should be once every shift of concrete placement. When the test data from four consecutive tests for each type of testing show only test results which comply with the provisions in these specifications, the frequency of the testing, on approval of the Contracting Officer, may be reduced.

4.4 Curing Compounds: Shall be certified by the manufacturer for compliance with the specifications.

4.5 Joint Filler Materials: Expansion joint filler and contraction joint inserts will be certified for conformance with specification requirements.

5. DELIVERY AND STORAGE OF MATERIALS:

5.1 Cement and Pozzolan: Cementitious materials shall be dry and free from

lumps and caking when delivered. Immediately upon receipt at the site of the work, cementitious materials shall be stored in a dry, weathertight, and properly ventilated structure.

5.2 Aggregates: Each size of aggregate shall be stored separately in free-draining stockpiles and shall be handled and stored in such manner as to avoid breakage, segregation, or contamination by foreign materials.

6. MATERIALS:

6.1 Aggregate: Fine and coarse aggregates shall conform to ASTM C 33 and the requirements herein. Coarse aggregate shall consist of crushed or uncrushed gravel, crushed stone, or a combination thereof. Fine aggregate shall consist of natural and/or manufactured sand.

6.1.1 For concrete requiring larger than 1 inch maximum size aggregate, the coarse aggregate shall be provided in two or more fractional sizes and used in concrete in the proportions that will produce a combined coarse aggregate gradation within the appropriate range specified in ASTM C 33.

6.1.2 Size and Grading: The maximum nominal size of the coarse aggregate shall be 1-1/2 inches.

6.1.3 Deleterious Substances: The amount of deleterious substances in each size group shall not exceed the limits shown below, determined in accordance with ASTM C 142, C 117, C 123, C 295 and CRD-C 130 (applicable only to material coarser than 3/8 inch).

Deleterious Materials

Material	Percentage by Weight	
	Coarse Aggregate(1)	Fine Aggregate
(2)		
Clay lumps and friable particles	1.0	1.0
Material finer than No. 200 sieve	1.0 (3)	3.0
Lightweight particles	1.0 (4)	0.5
Other soft particles	2.0	

NOTES:

1 The total of all deleterious substances shall not exceed 4.0 percent of the weight of the aggregate. The percentage of material finer than No. 200 sieve shall not be included in this total.

2 The total of all deleterious materials shall not exceed 3.0 percent of the weight of the aggregate.

3 Limit for material finer than No. 200 sieve will be increased to 1.5 percent for crushed aggregates consisting of crusher dust that is essentially free from clay or shale.

4 The separation medium shall have specific gravity of 2.0.

6.2 Air-entraining Admixture: Air-entraining admixture shall be an approved substance or compound conforming to ASTM C 260.

6.2.1 Retarder: A retarding admixture shall meet the requirements of ASTM C 494, Type B, except that the 6-month and 1-year compressive strength tests are waived. The use of the admixture is at the option of the Contractor and may only be used for fixed form placement method. Retarder may not be used for slipform placing method.

6.2.2 Water-Reducer: A water-reducing admixture shall meet the requirements of ASTM C 494, Type A or D except that the 6-month and 1-year compressive strength tests are waived. The admixture may be added to the concrete mixture only when its use is approved or directed. Type D admixture may not be used for slipform paving.

6.3 Cement: Cement shall be portland cement conforming to ASTM C 150, Type I or II, Low Alkali Content. The physical requirements for false set shall apply.

6.6 Joint Filler:

6.6.1 For Expansion Joints: Filler shall be preformed materials conforming to ASTM D 1751 or ASTM D 1752.

6.6.2 For Contraction Joints: Sawable type contraction joint inserts shall conform to ASTM D 2828.

6.7 Reinforcement: All reinforcement shall be free from loose flaky rust, loose scale, oil, grease, mud, or other coatings that might reduce and bond with concrete.

6.8 Water: Water for washing aggregate and for mixing and curing concrete shall be fresh and free from injurious amounts of oil, acid, salt, alkali, organic matter, or other deleterious substances.

6.9 Epoxy Resin: Epoxy resin shall conform to ASTM D 881.

6.10 Tie-down anchors shall be of the type indicated on the drawing, attached at the end of this section (File No. 150-25-1223).

7. GRADE CONTROL: The lines and grades shown for each pavement category of the contract shall be established and maintained by means of line and grade stakes placed at the jobsite by the Contractor in accordance with the SPECIAL PROVISIONS. Elevations of all bench marks used by the Contractor for controlling pavement operations at the jobsite and for finished pavement grade lines and elevations will be established and maintained by the Government.

8. PROPORTIONING:

8.1 Mixture Proportions: The proportions of all material entering into the concrete mixtures shall be as determined in Paragraph: STRENGTH AND AIR CONTENT. The proportions will be changed only when necessary to maintain the workability, strength, and standard of quality required for the concrete covered by these specifications, and to meet the varying conditions encountered during the construction. Changes shall be the responsibility of the Contractor, and the Contracting Officer shall be notified in writing.

8.1.1 Average Strength

In meeting the strength requirements specified, the selected mixture proportion shall produce an average compressive strength exceeding the specified strength by the amount indicated below. Where a concrete production facility has test records, a standard deviation shall be established. Test

records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected; shall represent concrete produced to meet a specified strength or strengths within 1000 psi of that specified for proposed work; and shall consist of at least 30 consecutive tests. A strength test shall be the average of the strengths of two cylinders made from the same sample of concrete and tested at 28 days or at other test age designated for determination of the specified strength.

8.1.2 Test Records Exceeding 29

Required average compressive strength used as the basis for selection of concrete proportions shall be the larger of the specified strength plus the standard deviation multiplied by 1.34 or the specified strength plus the standard deviation multiplied by 2.33 minus 500.

8.1.3 Test Records Less Than 29

Where a concrete production facility does not have test records meeting the above requirements but does have a record based on 15 to 29 consecutive tests, a standard deviation may be established as the product of the calculated standard deviation and a modification factor from the following table:

No. of tests (1)	Modification factor for standard deviation
less than 15	See Note
15	1.16
20	1.08
25	1.03
30 or more	1.00

(1) Interpolate for intermediate numbers of tests.

When a concrete production facility does not have field strength test records for calculation of standard deviation or the number of tests is less than 15, the required average strength shall be:

- a. The specified strength plus 1000 specified strength of less than 3000 psi.
- b. The specified strength plus 1200 for specified strengths of 3000 to 5000 psi.

c. The specified strength plus 1400 for specified strengths greater than 5000 psi.

8.2 Measurement: All aggregates and cementitious materials shall be measured by weight. Mixing water and air-entraining admixtures may be measured by volume or by weight. One gallon of water will be considered as 8.33 pounds.

8.3 Workability: The water content of the concrete shall be the minimum necessary to obtain the workability required for the specific conditions and methods of placement. The slump of the concrete shall be maintained at the lowest practical value and shall not exceed 2 inches for concrete placement using fixed forms or 1-inch for slip-form placement, when tested in accordance with ASTM C 143. Every effort shall be made to insure that the concrete, as it reaches the paver, is as uniform as possible from batch to batch. If wet batches are encountered, they shall be wasted. If the addition of water is necessary to provide the required slump to the mixed concrete, the mixture design water-cement ratio shall not be exceeded.

9. EQUIPMENT, APPROVAL AND MAINTENANCE: Dependable and sufficient equipment that is appropriate and adequate to meet the approved plan and schedule for the work specified shall be furnished by the Contractor and assembled at the work site sufficiently early before the start of paving to permit thorough inspection, calibration of weighing and measuring devices, adjustment of parts, and making required repairs. The equipment shall be approved in writing by the Contracting Officer and maintained in good working condition by the Contractor.

10. SUBGRADE, BASE, FORMS, AND STRINGLINE:

10.1 Underlying Material: The prepared surface of the subgrade or base course material shall be kept free of foreign matter, waste concrete and/or cement, and debris at all times and shall be thoroughly wetted down sufficiently in advance to insure a firm, moist condition when the concrete is placed. In cold weather the underlying material shall be prepared and so protected that it will be entirely free from frost when the concrete is placed. The use of chemicals to eliminate frost in the underlying material will not be permitted. Crossing of the prepared subgrade at specified intervals for construction purposes may be permitted for any type of subgrade, provided rutting or indentations do not occur. If traffic has been allowed to use the prepared subgrade, the surface shall be checked and corrected before concrete is placed.

10.2 Forms: Forms shall be of steel, except that wood forms may be used on curves having a radius of 150 feet or less, and for fillets. Forms shall be

equal in depth to the edge thickness of the slab as shown, and shall not be built up except as permitted below. When the project required several different slab thicknesses, forms may be built up with metal or wood to provide an increase in depth of not more than 25 percent.

10.2.1 Steel forms shall be furnished in sections not less than 10 feet in length, except that on curves having a radius of 150 feet or less, the length of the sections shall be five feet unless the sections are flexible or curved to the proper radius. The top surface of a form shall vary not more than 1/8 inch in 10 feet from a true line. The face of the form shall vary not more than 1/4 inch in 10 feet from a true plan. Forms with battered top surfaces, warps, bends, kinks, or distorted faces or bases shall be removed from the project.

10.2.2 Wood forms for curves and fillets shall be made of well-seasoned surfaced plank or plywood, straight, and free from warp or bend. Wood forms shall be adequate in strength and rigidly braced.

10.3 Form Setting: The forms shall be set on firm material cut true to grade so that each form section when placed will be firmly in contact with the underlying layer for its entire length and base width. The length of pins and quantity provided in each section shall be sufficient to hold the form at the correct line and grade. When tested by a 12-foot straight-edge, the top of the form shall conform to the requirements specified for the finished surface of the concrete. Forms shall be set well in advance of concrete placement. They shall be cleaned and oiled each time before concrete is placed.

10.4 Stringline: Stringline shall be accurately and securely installed well in advance of concrete placement. Staked supports shall be placed at intervals to eliminate sag with the stringline is tightened. The stringline shall be high strength wire that will allow sufficient tension to be applied to remove sag between supports. The stringline at the supports shall be easily adjusted in both the horizontal and vertical directions. When necessary to leave gaps in the stringline, supports on either side of the gap shall be secured to avoid disturbing the remainder of the stringline when the portion across the gap is positioned and tightened. Vertical and horizontal positioning of the stringline shall be such that the finished pavement shall conform to the alinement and grade elevations shown.

11. BATCHING, MIXING AND TRANSPORTATION:

11.1 Type of Plant: The Contractor shall provide semiautomatic or automatic batching and mixing plant conforming to the applicable requirements of ASTM C 94, except as specified below. The batching plant or central mixing plant may be located on or off the Government premises as approved.

11.1.1 Scales: The Contractor shall provide standard test weights and any other auxiliary equipment required for checking the operating performance of each scale or other measuring device. Periodic tests shall be made when and as directed, in the presence of the Contracting Officer. Upon completion of each check test and before further use of the indicating, or control devices, such adjustments, repairs, or replacements shall be made as required to secure satisfactory performance.

11.1.2 Protection: Weighing, indicating, recording and control equipment shall be protected against exposure to dust and weather.

11.2 Concrete Mixers:

11.2.1 General Requirements: The mixing time will be increased when necessary to secure the required uniformity and consistency of the concrete. Excessive overmixing requiring additions of water will not be permitted. The mixers shall be maintained in satisfactory operating condition, and mixer drums shall be kept free of hardened concrete. Mixer blades shall be replaced when worn down more than 10 percent of their original depth. The use of a mixer that at any time produces unsatisfactory results shall be promptly discontinued until repaired.

11.2.2 Central Mix Plant:

NOTE: This paragraph shall be used if slipform paving is utilized.

The minimum mix time for central mix plant stationary mixers shall be 80 seconds timed after all solid materials are in the mixer drum. All the mixing water shall be introduced before one-fourth of the mixing time has elapsed. This mix time may be reduced provided that mixer performance tests performed in accordance with Paragraph: MIXER EFFICIENCY TESTS indicate that satisfactory mixes can be achieved at a reduced mix time. The rate of rotation of the mixer drum shall be the manufacturer's specified speed.

11.2.3 Mixer Efficiency Tests: Test shall be conducted in accordance with the concrete uniformity requirements in ASTM C 94. Corrective measures shall be taken if test results are outside the limits established in ASTM C 94.

11.2.4

NOTE: Add this paragraph only for fixed form placement.

Truck mixers shall be used for fixed form placement. Transportation of

concrete batched at a batch plant shall be transported to the point of placement by truck agitator or truck mixer. Truck mixers, the mixing of concrete therein, and concrete uniformity, shall conform to the requirements of ASTM C 94. A truck mixer may be used either for complete mixing (transit mixing) or to finish the partial mixing done in a stationary mixer (shrink-mixed). Each truck shall be equipped with two counters from which it will be possible to determine the number of revolutions at mixing speed and the number of revolutions at agitating speed.

11.3 Transportation Equipment:

11.3.1

NOTE: This paragraph shall be used for slipform paving. [Transportation of concrete mixed completely in a stationary mixer from the mixer to the point of placement shall be rear dump trucks].

All transporting equipment shall conform to ASTM C 94 except as modified herein. Vehicles and equipment transporting concrete shall be capable of delivering and discharging the concrete without segregation. The transfer and distribution of the concrete from vehicles shall be by mechanical spreader, or concrete bucket and crane. When permitted to operate on stabilized subgrade, concrete may be discharged in front of the paver.

12. PLACING:

12.1 General: Concrete may be placed between stationary forms or it may be constructed to the desired cross section using slip-form pavers.

NOTE: Delete references to slipform paving if slipform paving is not an option. [Concrete shall be deposited in front of the slip-form paver within 45 minutes from the time all ingredients are charged into the mixing drum].

Concrete shall be deposited as close as possible to its final position in the pavement cross section. When concrete is truck mixed or when a truck mixer is used for transporting concrete, the concrete shall be deposited between the stationary forms within 1-1/2 hours from the time the cement is introduced to the aggregates. When the length of haul makes it impossible to deliver truck mixed concrete within these time limits, batching of cement and a portion of the mixing water shall be delayed until the truck mixer is at or near the construction site. At no case shall the water cement ratio of the proposed mix be exceeded by the addition of extra mixing water. Concrete shall be deposited

as close as possible to its final position in the pavement cross section.

12.2 Slip-form Method: The slip-form paver shall be self-propelled, automatically controlled, and crawler-mounted; capable of spreading, consolidating, and shaping the plastic concrete to the desired cross section in one pass. The paver shall be capable of finishing the surface and edges so that a minimum amount of hand-finishing is required, and have sufficient weight and power to handle the amount of concrete required for the full-lane width as specified. The mechanisms for forming the pavement shall be easily adjustable in width and thickness. Horizontal and vertical alignments shall be referenced to a taut stringline or the edge of a previously placed lane. The vibrators and/or tamping elements shall be automatically controlled so that they shall be stopped as forward motion ceases. When the paver approaches a header at the end of a paving lane, a sufficient amount of concrete shall be maintained ahead of the paver to allow a roll of concrete to spill over the header. The amount of extra concrete shall be sufficient to prevent the slurry that is formed and carried along ahead of the paver from being deposited adjacent to the header. The spud vibrators on the front of the paver should be brought as close to the header as possible before they are lifted. Additional consolidation shall be provided adjacent to the headers by hand-manipulated vibrators. Slip form pavers using transversely oscillating screeds shall not be used to form fill-in lanes that have widths less than a full width for which the paver was designed. The slip-form paver shall be equipped with a screw-type spreader to distribute the plastic concrete evenly and uniformly before the paver. Precautions shall be taken to prevent concrete from falling beneath the slip-form crawler tracks, and to prevent damage to previously constructed lanes when the paver travels on the edges. Steel bulkheads for beginning and end of each shift shall be securely anchored in place prior to placement of concrete by slip-form method.

12.3 Spreading:

NOTE: Delete this paragraph if slipform paving is not utilized.

Spreading shall be by machine method, with the concrete discharging directly in front of the paver. Mechanical spreaders shall be designed and operated to distribute the plastic concrete uniformly across the full width of the paving lane. Machines that cause displacement of properly installed forms or ruts or indentations in the prepared underlying material, and machines that cause frequent delays due to mechanical failures shall be replaced as directed. When the spreader rides the edges of previously constructed lanes, provisions shall be made to prevent damage to that pavement. The spreading of the concrete shall be performed at such elevations, slightly above grades, that, when properly consolidated, the surface will be at the elevation indicated. A

traveling blade for leveling will not be allowed for slip-form equipment.

12.4 Vibration:

NOTE: Delete this paragraph if slipform paving is not utilized.

Concrete shall be consolidated with mechanical vibrating equipment immediately after spreading. Vibrating equipment shall be of the internal type and the number of units and the power of each unit shall be adequate to properly consolidate all of the concrete. The vibrating unit shall be mounted on a frame or on the paver and equipped with suitable controls, so that all vibrators may be operated at any desired depth within the slab, or completely withdrawn from the concrete, as required. The spacing paving lane shall not exceed 24 inches. The outside elements of the internal spud vibrator units shall be approximately 9 inches from the edge of the slab. Vibrators of this type shall be inserted into the concrete to a depth that will provide the best consolidation, but not closer to the underlying material than 2 inches. Concrete in odd shaped slabs or in locations inaccessible to the above vibrating equipment shall be vibrated with a hand-manipulated vibrator. Vibrators shall not be used to transport or spread the concrete in the forms. Vibrators shall operate at a frequency of not less than 8000 impulses per minute when in the concrete, and shall not be operated in the concrete at one location for more than 20 seconds. Forward motion of the paver shall cease as soon as a vibrator becomes inoperable and shall not start until the vibrator is repaired or replaced. At least one additional vibrator, shall be maintained on the site at all times.

the specified curing period. Concrete damaged by freezing shall be removed and replaced in conformance with Paragraph: REMOVAL AND REPLACEMENT OF DEFECTIVE PAVEMENT AREAS below.

12.7 Placing During Warm Weather: During periods of warm weather when the maximum daily air temperature is likely to exceed 85 degrees F, the following precautions shall be taken. The forms shall be sprinkled with water immediately before placing the concrete. The concrete temperature shall not exceed 90 degrees F when placed. The aggregates and/or mixing water shall be cooled as necessary.

13. FIELD TEST SPECIMENS:

13.1 General: Concrete samples shall be furnished by the Contractor, and shall be taken in the field by the Contractor at his expense to determine the slump, air content, and strength of the concrete. Cylinders will be made for determining conformance with the strength requirements of these specifications and, when required, for determining the time at which pavements may be placed in service. The air content will be determined in conformance with ASTM C 231. Test cylinders shall be molded and cured in conformance with ASTM C 31. The Contractor shall furnish all materials, labor and facilities required for molding, curing, and protecting test cylinders at the site and under the supervision of the Contracting Officer.

13.2 Specimens for Strength Tests: Compressive strength cylinders shall be made each shift that concrete is placed. Each group of cylinders shall be molded from the same batch of concrete, and shall consist of a sufficient number of specimens to provide two tests at each test age. One group of specimens shall be made during each shift. However, at the start of paving operations and when the aggregate source, aggregate characteristics, or mix design is changed, additional groups of test cylinders may be required until the Contracting Officer is satisfied that the concrete mixture being used complies with the strength requirements of these specifications. Test ages shall be 7 days and 28 days.

14. FINISHING: Finishing operations shall be started immediately after concrete placement. Finishing shall be by the machine method except that where so indicated, the hand method will be permitted on odd slab widths or shapes and in event of breakdown of the mechanical equipment to finish concrete. The sequence of operations shall be as follows: screeding, consolidation, floating, straightedging, and texturing.

14.1 Machine Finishing - Fixed Forms:

14.1.1 Equipment: The finishing machine shall be operated to strike-off

screed, and consolidate the concrete. Machines that cause displacement of side forms or that cause frequent delays due to mechanical failure shall be replaced. Finishing machines riding the edge of a previously constructed slab shall be made to protect the surface to these slabs.

14.1.2 The finishing machine shall make as many trips over each area of pavement as necessary to compact the concrete and produce a surface of uniform texture, true to grade. However, excessive manipulation that brings to the surface an excess of mortar and water will not be permitted, and any equipment that cannot produce the required compaction and surface finish without an excessive number of trips will be considered unsatisfactory. The top of the form or pavement edge upon which the finishing machine travels shall be kept clean.

14.1.3 Mechanical Floating: After completion of finishing, the mechanical float shall be operated to smooth and finish the pavement to grade. If required, additional concrete shall be placed and screeded, and the float operated over the same area until a satisfactory surface is produced.

14.1.4 Other Types of Finishing Equipment: Concrete finishing equipment of types other than specified above may be used on a trial basis. The use of equipment that fails to produce finished concrete of the quality and consistency required by these specifications shall be discontinued, and the concrete shall be finished with approved equipment and in the manner specified above.

14.2 Finishing-Slip-Form Method: The slip-form paver shall be capable of finishing the surface and edges so that only a minimum of additional work is necessary. A self-propelled pipe float may be used if the Contractor desires, while the concrete is still plastic, to remove minor irregularities and score marks. Straight-edge finishing may be used as required; however, its use shall be kept to a minimum. The pipe float shall be 6 to 10 inches in diameter and sufficiently long to span the full paving width when oriented at an angle of approximately 60 degrees with the centerline. Concrete slurry permitted to run down the vertical edges of the sloped concrete will be removed by hand, using stiff brushes or other approved scrapers. Concrete slurry will not be used to build up along the edges of the concrete to compensate for excessive edge slump. Wood or metal forms shall be available for use in repairing edges that slough. In locations where sloughing occurs, the wood or metal forms shall be securely attached to the subgrade in the proper location and the defective edges corrected to the permissible tolerances. These procedures are to be used sparingly, and should excessive sloughing occur, operations will be halted until proper corrective adjustments have been made. Such procedures are not to be considered as routine corrective measures for edge instability.

14.3 Hand Finishing:

14.3.1 Equipment: Vibrators, a strike template, and a longitudinal float shall be provided for hand finishing. The template shall be at least one foot longer than the width of pavement being finished and shall be of an approved design, sufficiently rigid to retain its shape, and constructed of metal or other suitable material shod with metal. The longitudinal float shall be at least 10 feet long, of approved design, rigid and substantially braced and shall maintain a plane surface on the bottom of the base.

14.3.2 Finishing and Floating: After vibration, the concrete shall be struck off and screeded to the crown, cross section, and elevation required. If necessary, additional concrete shall be placed and screeded, and the float operated until a satisfactory surface has been produced.

14.4 Surface Correction and Testing: After transverse finishing is completed but while the concrete is still plastic, the surface shall then be tested for trueness with a 12-foot straightedge held in successive positions parallel and at right angles to the centerline of the pavement, and the whole area covered as necessary to detect variations. The straightedge shall be advanced along the pavement in successive stages. Depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated, and refinished. Projections above the required elevation shall also be struck off and refinished. The straightedge testing and finishing shall continue until the entire surface of the concrete is free from observable departure from the straightedge and conform to the surface requirements specified under subparagraph: "Surface Smoothness" below.

14.5 Texturing: Before the surface sheen has disappeared and before the concrete becomes nonplastic, the surface of the pavement shall be given the texture as shown in the plans and described below.

14.5.1 Burlap-Drag Texture:

NOTE: This method is typically used for slipform paving.

Surface texture shall be applied by dragging the surface of the pavement, in the direction of the concrete placement, with an approved multiple-ply burlap drag at least three feet in width and equal in length to the width of the slab. The leading transverse edge of the drag shall be securely fastened to a lightweight pole or traveling bridge, and at least one foot of the burlap shall be in contact with the pavement during dragging operation. The drag shall be operated with the burlap moist and the burlap shall be cleaned and changed as required. The dragging shall be done so as to produce a uniform

finished surface having a fine sandy texture without disfiguring marks.

14.5.2 Broom Texturing:

NOTE: Typically used for small projects.

Surface texture shall be applied using an approved hand or mechanical stiff bristle broom of a type that will produce uniform corrugations. For hand brooming, the brooms shall have handles longer than half the width of slab to be finished. The hand brooms shall be drawn transversely across the surface from the centerline to each edge with slight overlapping strokes. For mechanical operations, the broom shall be operated with the length of the broom parallel to the pavement centerline. The broom shall be capable of transversing the full width of the pavement in a single pass at a uniform speed and with a uniform pressure. Successive passes of the broom shall be overlapped the minimum necessary to obtain a uniformly textured surface. Brooms shall be washed thoroughly and dried at frequent intervals during use. Worn or damaged brooms shall be removed from the job site. Brooming should be completed before the concrete has dried to the point where the surface will be unduly torn or roughened, but after drying has progressed enough so that the mortar will not flow and attenuate the sharpness of the corrugations.

14.6 Edging: After texturing has been completed, the edge of slabs along the forms, where indicated or directed, shall be carefully finished with an edging tool to form a smooth surface of the required radius. Tool marks shall be eliminated, and the edges shall be smooth and true to line. No edging shall be performed on the edges of slipformed lanes.

14.7 Outlets in Pavement: Recesses for the tiedown anchors and other outlets in the pavement shall be constructed to conform to the details and dimensions shown. The concrete in these areas shall be carefully finished to provide a surface of the same texture as the surrounding area that will be within the requirements of PLAN GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS below.

15. FORM REMOVAL: Forms shall remain in place at least 12 hours after the concrete has been placed. When conditions are such that the early-strength gain of the concrete is delayed, the forms shall be left in place for a longer period as directed. Forms shall be removed without injuring the concrete. Any concrete found defective after form removal shall be satisfactorily repaired promptly.

16. CURING:

16.1 General: Concrete shall be protected against loss of moisture and rapid temperature changes for at least seven days from the beginning of the curing operation. Unhardened concrete shall be protected from rain and flowing water. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready to install before actual concrete placement begins. If any selected method of curing does not afford the proper curing and protection against concrete cracking, the damaged pavement will be removed and replaced and another method of curing shall be employed as directed.

16.2 Curing Procedures: Concrete curing shall be continued for the duration of the required curing period by the following method.

16.2.1 White Burlap-polyethylene Sheet: White burlap-polyethylene covers shall be at least one foot longer than necessary to cover the entire width and edge of the pavement lane. Adjacent mats shall overlap at least six inches. The mats shall be thoroughly wetted before placing and shall be kept continuously wet and in intimate contact with the pavement edges and surface for the duration of the required curing period.

16.2.2 Membrane Curing: A uniform coating of white pigmented membrane curing compound shall be applied to the entire exposed surface of the concrete as soon after finishing as free water has disappeared from the finished surface. Formed surfaces shall be coated immediately after the forms are removed and in no case longer than one hour after removal of forms. The concrete shall not be allowed to dry before the application of the membrane. If any drying has occurred, the surface of the concrete shall be moistened with a fine spray of water, and the curing compound applied as soon as the free water disappears. The curing compound shall be applied to the finished surfaces by means of an approved multiple nozzle automatic spraying machine. The curing compound in the drum used for the spraying operation shall be thoroughly and continuously agitated mechanically throughout the full depth of the drum during the application. The curing compound shall be applied with a coverage rate of not more than 200 square feet per gallon. The application of curing compound by hand-operated pressure sprayers will be permitted only on odd widths or shapes of slabs where indicated, and on concrete surfaces exposed by the removal of forms. Concrete surfaces that are subjected to heavy rainfall within three hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be resprayed.

17. PLAN GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS: The finished surfaces of airfield and heliport pavement, when tested as specified below in SURFACE

TESTS, DEFICIENCIES, AND CORRECTIONS, shall conform to the grade line and elevations shown and the surface-smoothness requirements specified herein.

17.1 Plan Grade: The finished surfaces of airfield and heliport pavement shall conform, within the tolerances shown in Table 1, to the lines, grades, and cross sections shown. The finished surface of airfield runway, taxiway, and apron pavements shall vary not more than 0.04 foot above or below the plan grade line or elevation established and approved at the jobsite in accordance with GRADE CONTROL above. However, the above 0.04 foot deviation from the approved grade line and elevation will not be permitted in areas where closer conformance with planned grade and elevation is required for the proper functioning of appurtenant structures. The finished surfaces of new abutting pavements shall coincide at their juncture. Where a new pavement abuts an existing pavement, transition pavement strip of the type and dimensions indicated shall be installed.

17.2 Surface Smoothness: The finished surface of airfield and heliport pavements shall have no abrupt change of one-eighth inch or more and shall not deviate from the testing edge of an approved 12 foot straightedge more than the tolerances shown for the respective pavement category in Table 1 below:

TABLE 1

Item No.	Pavement Category	Direction of Testing	Tolerances
1.	Runways and taxiways	Longitudinal	1/8 inch
		Transverse	1/4 inch
2.	Calibration hardstands & compress swinging bases	Longitudinal	1/8 inch
		Transverse	1/8 inch
3.	All other airfield & heli-copter paved areas	Longitudinal	1/4 inch
		Transverse	1/4 inch

NOTE: When slip-form paving is used, edge slump shall not exceed 1/4-inch. Use of slip-form paving equipment and procedures that fail to provide pavement edges within the above limitations will be discontinued and the pavements will be constructed by means of standard paving procedures with fixed forms.

18. SURFACE TESTS, DEFICIENCIES AND CORRECTIONS: The finished surface of

each pavement category of the contract shall be tested for conformance with the respective requirements of PLAN GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS above.

18.1 Equipment: The Contractor shall furnish and maintain at the jobsite in good condition, one 12 foot straightedge for each paving spread for use in testing the fresh and hardened portland-cement concrete surfaces. These straightedges shall be constructed of aluminum or magnesium alloy and shall have blades of box or box-girder cross section with flat bottom, adequately reinforced to insure rigidity and accuracy. Straightedges shall have handles for operation on the pavement.

18.2 Grade Conformance Tests: Each pavement category will be checked for conformance with subparagraph Plan Grade above. The finished surface will be treated by the Contracting Officer by running lines of levels at intervals of 25 feet or less apart longitudinally and transversely to determine the elevation of the completed pavement. Within 30 days after the completion of concrete placement in the respective pavement areas, the Contracting Officer will inform the Contractor in writing of all areas defective in plan-grade requirements.

18.3 Surface-smoothness Determinations: After the concrete has hardened sufficiently to permit walking thereon, but not later than 36 hours after placement, the surface of the pavement shall be tested by the Contractor with a 12 foot straightedge or other approved device, operated in such manner as to reveal all surface irregularities exceeding the tolerances specified in Table 1 above, except that deviations from the approved straightedge greater than specified tolerances caused by edge slump along slip formed longitudinal construction joints shall not be considered in smoothness determinations in the transverse direction. Deviations greater than specified tolerances caused by high areas along slipformed longitudinal construction joints shall be considered in smoothness determination in the transverse direction. The entire area of the pavement shall be tested in both a longitudinal and transverse direction on parallel lines five feet or less apart. The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. Straightedge lines shall be carried continuously across joints. Other devices that reveal surface irregularities exceeding specified tolerances may be used when approved. Straightedge testing for acceptance or rejection of the finished pavement surface will be performed by the Contracting Officer as soon as possible and not later than 48 hours after the end of the curing period, except that straightedge testing across longitudinal construction joints will be accomplished with 48 hours after the end of the curing period of the concrete placed in the adjacent lane.

18.4 Edge Slump Determination:

NOTE: Delete this paragraph if slipform paving is not used.

After the concrete has hardened sufficiently to permit walking thereon, the pavement surface shall be tested with a 12 foot straightedge or other approved device to reveal irregularities exceeding the edge slump tolerance specified in Paragraph: PLAN GRADE AND SURFACE-SMOOTHNESS REQUIREMENTS. The edge slump shall be determined at each edge of each paving lane constructed using a sliding form with the straightedge placed transverse to the direction of paving and the end of the straightedge located at the edge of the paving lane. Measurements shall be made at 5 to 25 feet spacing commencing at the header where paving is initiated. The measurements will be made by the Contracting Officer and properly referenced in accordance with established paving lane identification and stationing.

18.5 Deficiencies and Corrections:

18.5.1 High Areas: High areas shall be reduced either by rubbing the freshly finished concrete with carborundum brick and water when the concrete is less than 36 hours old or by grinding the hardened concrete with an approved surface grinding machine when the concrete is older than 36 hours. The area corrected by grinding the hardened surface shall not exceed 5 percent of the area of any integral slab and the depth of grinding shall not exceed 1/4 inch. All pavement areas requiring plan grade, surface smoothness or edge slump corrections in excess of the limits specified above, shall be removed and replaced in conformance with Paragraph: REMOVAL AND REPLACEMENT OF DEFECTIVE PAVEMENT AREAS. Areas exceeding 25 square feet that have been corrected by rubbing or grinding will be retextured by transverse grooving. The grooves shall be 1/8 to 1/4 inch on 2-inch centers and shall be carried into, and tapered to zero depth within the non-corrected surface. All areas in which rubbing or grinding has been performed will be subject to the thickness tolerances specified in Paragraph: TOLERANCE IN PAVEMENT THICKNESS.

18.5.2 Excessive Edge Slump:

NOTE: Delete this paragraph if slipform paving is not used.

High areas revealed by the edge slump measurements will be subject to the surface smoothness tolerances shown in Paragraph: PLAN GRADE AND SURFACE SMOOTHNESS REQUIREMENTS. When edge slump exceeding 1/4 inch is encountered, the Contractor shall take additional straightedge measurements to define its

limits. The concrete within these limits of excessive edge slump will be removed and replaced in conformance with Paragraph: REMOVAL AND REPLACEMENT OF DEFECTIVE PAVEMENT AREAS. Partial slabs removed and replaced shall extend across the full width of the pavement lane, and both the section of the slab removed and the section remaining in place shall have a minimum length of 10 feet to the nearest scheduled transverse joint.

19. TOLERANCES IN PAVEMENT THICKNESS: Pavements shall be of the thicknesses indicated on the plans. Deficiencies in the thickness shall be treated as described below. Testing shall be the responsibility of the Contractor and shall be performed by an approved commercial testing laboratory at no additional cost to the Government.

19.1 Thickness Determination: The thickness of the pavement shall be determined on the basis of measurements made on cores drilled from points in the pavement, within seven days after placement of the concrete. Cores generally shall be taken from every other lane of the paved area or as directed by the Contracting Officer. Measurement of individual cores shall be performed in accordance with ASTM C 174. The core holes shall be refilled by the Contractor with portland cement concrete bonded to the pavement with epoxy-resin grout.

19.2 Permissible Deficiency: Permissible deficiency in pavement thickness will be up to but not including 1/4-inch of the specified thickness.

19.3 Pavement Deficient in Thickness: When measurement of any core indicates that the pavement is deficient in thickness 1/4-inch or more, additional cores shall be drilled at 25-foot intervals along the center line of the lane on each side of the deficient core, until the cores indicate that the deficiency in thickness is less than 1/4-inch. Pavement areas deficient in slab thickness 1/4-inch or more shall be removed or replaced with pavement of the indicated thickness in conformance with Paragraph: REMOVAL AND REPLACEMENT OF DEFECTIVE PAVEMENT AREAS. Partial slabs to be removed and replaced shall extend across the full paving lane width midway between adjacent cores or to the regularly scheduled transverse joint should such a joint fall between the cores. If the Contractor believes that the cores and measurement taken are not sufficient to indicate fairly the actual thickness of the pavement, additional cores and measurements will be taken provided the Contractor will bear the extra cost of drilling the cores and filling the holes in the pavement as directed. When surface grinding and texture restoration is required that results in thickness deficiencies which exceed the permissible deviations, the concrete removal and replacement requirements will apply as contained in Paragraph: REMOVAL AND REPLACEMENT OF DEFECTIVE PAVEMENT AREAS, and PAYMENTS.

20. REPAIRS OF DEFECTIVE PAVEMENT SLABS: Broken slabs, random cracks, nonworking contraction joints near cracks, and spalls along joints and cracks shall be replaced or repaired as specified below. The Contracting Officer will be responsible for determining, by means of a structural evaluation, whether defective pavement shall be repaired as specified below or replaced as specified in Paragraph: REMOVAL AND REPLACEMENT OF DEFECTIVE PAVEMENT AREAS.

20.1 Spalls along joints or at other locations shall be repaired as specified in TM 5-822-9 at no additional cost to the Government.

20.2 Broken slabs and random cracks shall be repaired by pressure epoxy-grout injection as specified hereinafter at no additional cost to the Government.

20.2.1 Materials: Epoxy-resin based binder shall be two-component material formulated to meet the requirements of ASTM C 881, Type I, Grade I, Class determined by ambient temperature. Epoxy grout mixture shall be in accordance with manufacturer's recommendations for each particular area to be repaired.

20.2.2 Epoxy Injection:

20.2.2.1 Preparation of Crack Area: Remove all surface contamination by wire brushing, scraping or light sandblasting and remove dust in crack with light air jet. After approval of the preparation operation, the Contractor shall apply a seal to the surface of the crack, leaving ports for injection of epoxy material in accordance with the manufacturer's recommendations. After epoxy injection, the Contractor shall deepen the adjacent sawed joint to at least 1/3 the pavement thickness.

20.2.2.2 Epoxy Injection Placement: The Contractor shall perform the necessary drilling and grouting at all random cracks which develop. The epoxy material shall be proportioned and injected as recommended by the manufacturer of the material for the intended use. The concrete cracks shall be mapped and the injection shall be on center-to-center spacing necessary to perform structural bonding to the full depth of the crack. Epoxy injection of cracks shall not be started until the concrete has cured for a minimum of 7 days and the injection shall be completed within 14 days after placement.

21. REMOVAL AND REPLACEMENT OF DEFECTIVE PAVEMENT AREAS: Defective pavement shall be removed and replaced as specified herein with pavements of the thickness and quality required by these specifications. In no case shall concrete removal and replacement result in a slab less than the full paving lane width or a joint less than 10 feet from a regularly scheduled transverse joint. When a portion of the unfractured slab is replaced, a saw cut three

inches deep shall be made transversely across the slab in the required location, and the concrete shall be removed to provide an essentially vertical face in the remaining portion of the slab. Just prior to placement of concrete, the slab face shall be cleaned of debris and loose concrete, dust removed with light air jet, and then thoroughly coated with a thixotropic epoxy-resin adhesive manufactured specifically for bonding fresh portland cement concrete to existing hardened concrete. Longitudinal construction joints and transverse contraction joints shall not be coated with epoxy-resin adhesive. Asphaltic emulsion or other approved bond-breaking medium shall be pointed on vertical construction and contraction joint faces. Longitudinal and transverse joints of the replaced slab or portion thereof shall be constructed as indicated. The joints shall be sealed as specified in SECTION: FIELD MOLDED SEALANTS IN RIGID PAVEMENTS [or if Compression Seals are used, SECTION: PREFORMED ELASTOMERIC JOINT SEALS FOR CONCRETE PAVEMENTS]. The replaced pavement will be paid for at the contract price but no payment will be made for the defective pavements removed nor for the cost of removing the defective pavements.

22. JOINTS:

22.1 Longitudinal Construction Joints: Longitudinal construction joints between paving lanes shall be located as indicated. Tiebars and keys shall be installed in the longitudinal construction joints or the edges shall be in conformance with Paragraph: Dowels below. When the concrete is placed using stationary forms, metal forms securely fastened to the concrete form shall be used to form the keyway in the plastic concrete. When the concrete is placed using slip-form pavers, the keyway (female portion of the key) shall be formed in the plastic concrete by means of metal forms permanently attached to the side forms or by means of preformed metal keyway liners which are inserted during the slip-form operations and which may be left in place. The dimensions of the keyway forms shall not vary more than plus or minus 1/8 inch from the dimensions indicated and shall not deviate more than plus or minus 1/4 inch from the mid-depth of the pavement. Each slab edge, where more than 2 lineal feet of keyway fail to meet the specified tolerance, will be doweled for the full slab length (between transverse contraction joints). Longitudinal construction joints shall be edged (unless slipform method is used) and subsequently sawed to provide a groove at the top conforming to the details and dimensions indicated.

22.2 Transverse Construction Joints: Transverse construction joints shall be installed at the end of each day's placing operations and at any other points within a paving lane when concrete placement is interrupted for 30 minutes or longer. Insofar as practicable, transverse construction joints shall be installed in the location of a planned joint. When concrete

placement cannot be continued, the transverse construction joint may be installed within the slab unit but not less than 10 feet from a planned transverse joint. Transverse construction joints shall be doweled as shown. When the construction joint is located at planned transverse joints, one half of each dowel shall be painted and oiled to permit movement at the joint. These joints shall be edged and subsequently sawed to provide a groove at the top conforming to the details and dimensions indicated. When using slip-form pavers, transverse construction joint shall be constructed by utilizing headers and hand placement and finishing techniques. Pavement shall be constructed with the slip-form paver as close to the headers as possible and run out completely past the header.

22.3 Expansion Joints: Expansion joints shall be formed by means of a preformed filler material. The filler shall be securely held in position by means of approved metal supports which shall remain in the pavement. A removable metal channel cap bar shall be used to hold the parts of the joint in proper position and protect the filler from damage during concreting operations. The cap bar shall be removable without damage to the pavement to provide a space for sealing of the joint. Expansion joints shall be formed about structures and features that project through, into, or against the pavement, using joint filler of the type, thickness, and width indicated, and installed in such manner as to form a complete, uniform separation between the structure and pavement.

22.4 Contraction Joints: Transverse and longitudinal contraction joints shall be sawed if slip-form construction is used; otherwise they may be of the weakened-plane or dummy type, and shall be constructed as indicated. Longitudinal contraction joints shall be constructed by sawing a groove in the

weather conditions. The joints shall be sawed at the required spacing consecutively in the sequence of the concrete placement. The saw cut shall not vary more than 1/2 inch from the true joint alignment. Before sawing a joint, the concrete shall be examined closely for cracks, and the joint shall not be sawed if a crack has occurred near the joint location. Sawing shall be discontinued when a crack develops ahead of the saw cut. Immediately after joint is sawed, the saw cut and adjacent concrete surface shall be thoroughly flushed with water until all waste from sawing is removed from the joint. Any membrane-cured surface damaged during the sawing operations shall be resprayed as soon as the surface becomes dry. An ample supply of saw blades shall be available on the job before concrete placement is started, and at least one standby sawing unit in good working order shall be available at the jobsite at all times during the sawing operation.

22.4.2

NOTE: Can be used for fixed form placement. Cannot be used for slipform placement.

Insert type contraction joints shall be constructed by installation of a preformed insert in the plastic concrete to form a weakened plane to induce cracking. The insert materials shall conform to ASTM D 2628, D 2828 or CRD-C 572, whichever is applicable. The inserts shall be constructed so insert material can be removed to form a groove in the concrete as required in subparagraph 22.4.2.2. All types of inserts shall be approved prior to installation. Inserts shall be furnished in heights for the various depths of joints shown and in lengths equal to the full width of the paving lane. Equipment for installing inserts shall be a machine equipped with a vibratory bar for vibrating the insert into place at the prescribed joint location.

22.4.2.1 The insert shall be installed in the plastic concrete immediately following the final machine finishing with a maximum of two joint spacings between finishing and machine and inserter. Additional straightedge and texturing operations shall be accomplished without disturbing the installed insert. The insert shall be perpendicular to the finished grade of the pavement and the top of the insert shall be flush or not more than 1/8 inch below the pavement surface.

22.4.2.2 After the expiration of the curing period a groove for joint sealer shall be formed as specified below. The top portion of fiberboard fillers or sawable preformed inserts shall be removed by sawing with a power saw to form a groove of required dimensions. The sawing shall be so accomplished as to abrade the concrete surfaces in the joint groove and remove all traces of the filler or insert. Nonsawable insert material shall be removed as prescribed by the manufacturer. The dimensions and characteristics

of the groove thus formed shall be as shown. The grooves shall have edges free of ravel and spalls, and be straight from edge to edge of the pavement and shall not vary more than 1/2 inch from alignment.

22.5 Dowels - Fixed Form Installation: Fixed form installation of dowels shall be prepared and placed across joints where indicated, correctly aligned and securely held in the proper horizontal and vertical position during placing and finishing operations. Installation by removing and replacing dowels in preformed holes will not be permitted. Dowels in longitudinal and transverse construction joints shall be held securely in place parallel to the surface as indicated, by means of devices fastened to the form. Dowels in longitudinal joints shall be omitted when the center of the dowel would be located within a horizontal distance from a transverse joint equal to 1/4 of slab thickness. Dowels shall be installed within 1/8 inch per foot of length of correct alignment. The Contractor shall furnish as approved template for checking the position of the dowels. The portion of each dowel intended to move within the concrete or expansion cap shall be painted with one coat of red-lead or blue-lead paint. The painted portion shall be wiped clean and coated with a film of lubricating oil before concrete is placed.

22.6 Dowels - Slip Form Installation: For concrete placed using slip-form pavers dowels shall be placed in the horizontal position across joints where indicated. Dowels in longitudinal construction joints shall be placed only by means of bonding the dowels into holes drilled into the hardened concrete. Holes approximately 1/8 inch greater in diameter than the dowels shall be drilled into the hardened concrete using approved diamond-bit core drilling equipment, and the dowels shall be bonded in the drilled holes using an epoxy resin grout meeting ASTM C 881. The procedure for installation of dowels in longitudinal construction joints must be submitted for approval.

22.7 Sealed Joints: Joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit, as directed. Joints shall be sealed as specified in SECTION: FIELD MOLDED SEALANTS IN RIGID PAVEMENTS [or if Compression Seals are used, SECTION: PREFORMED ELASTOMERIC JOINT SEALS FOR CONCRETE PAVEMENTS].

23. PAVEMENT PROTECTION: The Contractor shall protect the pavement against all damage prior to final acceptance of the work by the Government. Traffic shall be excluded from the pavement until the concrete is at least 14 days old, or for a longer period if so directed. As a construction expedient in paving intermediate lanes between newly paved lanes, operation of the paver and batch-hauling equipment will be permitted on the pavement after the pavement has been cured for seven days and the joints have been sealed or otherwise protected. Also, the subgrade planer, a concrete finishing machine, and similar equipment may be permitted to ride upon the edges of previously

constructed slabs when the concrete has attained a minimum flexural strength of 400 lbs/in², and provided further that adequate means are furnished to prevent damage to the slab edge.

24. MEASUREMENT:

24.1 Concrete: The quantity of concrete to be paid for will be the number of cubic yards placed in the completed and accepted pavements. Concrete will be measured in place in the completed and accepted pavements in accordance with the dimensions shown in plan and cross section. No deduction will be made for rounded or beveled edges or space occupied by pavement reinforcement, dowel bars, or electrical conduits, nor for any void, drainage, or other structure extending into or through the pavement slab, measuring three cubic feet or less in volume, no other allowance for concrete will be made unless placed in specified locations in accordance with written instructions previously issued by the Contracting Officer.

24.2 Dowels: The quantity of dowels and tie bars used in the work will not be measured for payment, but will be considered as a subsidiary obligation of the Contractor, covered under the price per cubic yard for concrete.

24.3 Tie-down anchors will not be measured for payment, but will be considered as a subsidiary obligation of the Contractor covered under the price per cubic yard for concrete.

25. PAYMENT:

25.1 Concrete: The quantity of concrete, measured as above specified, will be paid for at the contract unit price when placed in completed and accepted pavements of satisfactory thickness and smoothness as above specified. The unit price for concrete shall include the cost of all labor and materials, and the use of all equipment and tools required to complete the concrete work.

26. CONTRACTOR QUALITY CONTROL:

26.1 General: The Contractor shall perform the inspection and tests described above and in Paragraph: INSPECTION DETAILS AND FREQUENCY OF TESTING. All testing shall be accomplished by use of the Contractor's own laboratory or by using the services of a commercial laboratory approved by the Contracting Officer. The Government reserves the right to check laboratory equipment employed for compliance with the test standards, and the right to sample and test materials at any time.

26.2 Inspection Details and Frequency of Testing:

26.2.1 Fine Aggregate:

26.2.1.1 Grading: During each shift when the concrete plant is operating there shall be one sieve analysis in accordance with ASTM C 136 for the fine aggregate.

26.2.1.2 Moisture Content: Two tests for moisture content in accordance with ASTM C 70 and ASTM C 566 will be made during each shift of mixing plant operation. An additional test shall be made whenever the slump is shown to be out of control or excessive variation in workability is reported by the placing foreman.

26.2.2 Coarse Aggregate:

26.2.2.1 Grading: During each shift in which concrete plant is operating there shall be a sieve analysis in accordance with ASTM C 136 for each size of coarse aggregate. Samples shall be taken from the batch plant bins.

26.2.3 Deleterious Materials: During each shift there shall be one petrographic examination for deleterious materials made in accordance with the applicable provisions of ASTM C 295 and the requirements hereinbefore stated, of each size of coarse aggregate. Samples shall be taken from the batch plant bins. Frequency of testing may be reduced as approved following tests that meet requirements stated for 5 shifts of concrete placement.

26.2.4 Scales: The accuracy of the scales shall be checked by test weights as directed by the Contracting Officer, for conformance with the applicable requirements of NBS Handbook 44. Once a week the accuracy of each batching device shall be checked during a weighing operation by noting and recording the required weight, and the actual weight batched.

26.2.5 Batch-Plant Control: When the concrete plant is operating, the measurement of all constituent materials including cement, each size of aggregate, water and admixtures shall be continuously monitored. The aggregate weights and amount of water subtracted to compensate for free moisture in the aggregates shall be adjusted as necessary. The amount of air-entraining agent shall be adjusted to control air content within specified limits. A report shall be prepared indicating type and source of cement used, amount and source of admixtures used, aggregate source, the required aggregate and water weights per cubic yard, amount of water as free moisture in each size of aggregate and the batched aggregate and water weights per cubic yard for each class of concrete batched during plant operation.

26.2.6 Concrete:

26.2.6.1 Two tests for air content shall be made on randomly selected batches of concrete during each shift of concrete production. Additional tests shall be made when excessive variation in workability is reported by the placing foreman or Government inspector. Tests shall be made in accordance with ASTM C 231.

26.2.6.2 A minimum of two slump tests shall be made on randomly selected batches of each class of concrete during each 8 hour period of concrete production in accordance with ASTM C 143. Additional tests shall be made when excessive variations in workability is reported by the placing foreman or Government inspector.

26.2.6.3 A minimum of one set of four cylinders shall be made for each shift of concrete placement. However, at the start of paving operations and when the aggregate source, aggregate characteristics, or mix proportioning is changed, additional sets may be required until the Contracting Officer is satisfied that the concrete mixture being used complies with the strength requirements of these specifications. Test cylinders shall be tested in pairs at 7 days and 28 days of age. One slump and air content test of those hereinbefore specified shall be taken with each set of cylinders. Concrete samples shall be secured in conformance with ASTM C 31, except that the use of cardboard molds will not be permitted.

26.2.7 Curing:

26.2.7.1 No curing compound shall be applied until the Contractor has verified that the compound is properly mixed and ready for spraying. At the end of each shift the Contractor shall determine the quantity of compound used and the area of concrete surface covered and compute the rate of coverage in square feet per gallon, noting whether coverage is uniform.

26.3 Reports: All results of tests conducted at the project site shall be reported in accordance with SECTION: CONSTRUCTION QUALITY CONTROL.

27. CONSTRUCTION QUALITY CONTROL: Attention is directed to SECTION: CONSTRUCTION QUALITY CONTROL which requires the Contractor to perform quality control inspection, testing, and reporting.

ADDITIONAL NOTES

NOTE A: This specification is typically used for exterior concrete with placements no greater than 10,000 cubic yards. Use a CEGS 02515 concrete specification when placements exceed 10,000 cubic

yards.

NOTE B: Types of admixtures (i.e. pozzolans, water reducers, etc...) maybe different in each locality. Change accordingly.

NOTE C: If the project is small then delete all requirements for slipform paving.

NOTE D: Surface smoothness will be not as stringent if the project is a roadway or a concrete pad. We have been using a 3/8" requirement for smoothness for roads and pads.

--End--